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Tube with a Tube Line Guided through its Interior and Held on the Tube Wall

The invention relates to a tube with a tube line guided through its interior and held on the tube wall, said tubes having a small cross-section, in particular a heating tube for condensing steam with a deaeration line.

In apparatus and machine construction, it is rather often necessary to provide tubes or other hollow bodies with a line guided though the interior of the body, the cross-section of said line being small in comparison to the cross-section of the tube or the hollow body. Thus, for example, a steamed-heated drum with heating tubes connected to a common steam chamber and heated by condensing steam is known from DT-PS 1 604 843. The heating tubes reaching over almost the entire length of the drum each contain a deaeration line that permits the air pulled into the tubes with the hot steam to be removed, so that the formation of an air cushion in the tubes is avoided along with the disadvantages associated therewith. Previously, it was customary to support the deaeration line in the heating tube by spring clips mounted at certain

intervals on the line on the inner side of the tube wall. In this way, the deaeration line was also fixed in its position relative to the tube when the drum rotated. This fixation of the line requires the application of a greater number of spring clips to the thin line, which is associated with a significant expenditure of labor. The spring clips had to consist of spring steel even if the tube and the line located therein were made of another metal such as, for example, aluminum. Since the condensate water recycling through the tube always also contains small amounts of electrolyte, a rapid corrosion of the aluminum resulted at the contact points of the two metals.

The objective of the invention consists in providing a secure retention of a comparably thin tube line in an elongated hollow body, in particular a tube. Moreover, the drawing in of the tube line and its fixation should be possible with little expenditure of labor and also for large tube lengths. In particular, the secure retention of the line should be ensured even on rotation of the tube as well as in case of strong external impacts such as, for example, occur in steam tube calcining drums.

According to the invention, this objective is realized by the fact that the line is provided over at least one part of its length with periodic bends whose amplitude is greater than the bore of the tube, so that the line is deformed on drawing into the tube and, due to its restoring force, abuts the tube under pressure. Since the amplitude A of the line bend is greater than the bore L of the tube and, consequently, the line on drawing

into the tube is deformed to the extent that the amplitude A of its bend is reduced to the bore L, a secure seat resistant to displacement results after the drawing in. The tube preferably has a circular cross-section, but can also have a different, e. g. elliptical or square, cross-section.

According to the preferred form of embodiment of the invention, the line is bent in the form of a wave with point contact of the tube wall. The wave length is 6 to 50 times, preferably 15 to 30 times the inner diameter of the tube. In the case of heating tubes with an inner diameter of 10 cm, the wave length is, for example, 2 m.

According to another form of embodiment of the invention, the line is bent in the form of a helical spring. In this case, the outer diameter of the helical spring before the drawing in of the line is greater than the inner diameter of the tube, so that the line after being drawing in lies elastically along a helical line against the inner side of the tube wall.

Furthermore, it is provided that the difference between the amplitude A of the line bending and the bore L of the tube is dimensioned so large that, in the line deformation associated with the drawing in, the elastic range of the line material is not exceeded. Thus, it is ensured that the line lies resiliently against the tube wall after drawing in and holds in its position independently without additional means of assistance. Preferably,

the amplitude of the periodic line bending is greater than the bore of the tube by 10% to 40%, in particular 16% to 32%.

Expediently, the pressing force of a line bent in the form of a wave on the tube wall at each point of contact is equal to 3 to 10 times the weight of the drawn-in line length divided by half the number of contact points. Thereby, it is ensured that, even at large wave lengths or significant weight of the line between the two support points of a wave, no sagging of the line as a consequence of its weight or lifting from the tube wall is possible.

The most preferred field of use of the invention is a steam-heated drum with tubes connected to a common steam chamber, heated by condensing steam, and, according to the invention, provided with deaeration lines, where the ends of the tubes opposite the steam chamber are closed and the ends of the lines located near these ends of the tubes are open and the lines guided back to the steam inlet ends of the tubes are connected to a collector chamber that can be deaerated. While the condensate runs back through the tubes themselves, the air pulled in with the hot steam can be drawn off through the wavy, spiral, or bent periodically in another form, deaeration line abutting the inner side of the tube in a form-locking manner. The invention can, however, not only be used in said steam-heated drums. It is advantageous in all the cases where a comparably thin tube line is supposed to be disposed so that it cannot move in a longer hollow body, in particular

a tube. The retention according to the invention is suitable, i. a., also for lubricant lines that are guided through a tubular hollow space to the point to be lubricated.

Tube and line consist, to avoid corrosion, of the same material. The invention is not limited to certain materials. Metals such as, for example, aluminum, copper, brass, and steel, as well as plastics in special instances of application, can find application.

The introduction of the line into the tube is itself possible in the up to 20-m-long heating tubes of a steam tube calcining drum with little expenditure of labor. The drawing-in force increases as a consequence of the increasing number of contact points or the increasing length of the contact line (in the case of spiral line in a cylindrical tube) only until the drawing force acting at the drawing-in end of the line is so large that the front line piece connecting to the drawing-in end experiences a stretching and, thereby, the amplitude A of its bendings becomes smaller than the bore L of the tube, that is, the point or line contact between line and tube is eliminated. Consequently, the friction to be overcome on further drawing in at these points, or line, also disappears with the consequence that, despite increasing drawing-in length, there is always only a constant number of contact points or line contact. Only after removal of the drawing-in force is the deformation of the line caused by this eliminated as far as possible, that is, up to abutment of the tube wall. Through the increasing lifting of the line from the tube wall with increasing drawing-in length, it is possible to draw lines into very long tubes (20 m and more) without too high drawing-in forces exceeding the elastic limit of the line material being required.

Embodiment examples of the invention are explained in the following with the aid of the drawings. Shown in detail are:

Figure 1 a wavy line in a tube and

Figure 2 a schematic representation of a steam tube calcining drum with the heating tubes equipped according to the invention with wavy deaeration lines.

Figure 1 shows a wavy tube line 5 in a cylindrical tube 2. The wave amplitude A of the line 5 before its introduction is greater than the bore L of the tube 2 and, on drawing in, is unavoidably flattened to the bore L of the tube 2. Due to its elastic restoring force, the line 5 presses at contact points 12 and 13 against the wall of the tube 2. With increasing depth of drawing in, an increasing drawing-in force is first also required, because the friction to be overcome increases with the growing number of contact points.

After a certain drawing-in length that depends on the pressing force and the number of contact points, the coefficient of friction, and the elastic properties of the line material, the force of drawing in has grown so much that the line waves adjacent to the drawing-in end stretch, that is, the front contact points disappear. The drawing-in force then remains approximately constant, because the number of newly appearing contact points is approximately equal to the contact points disappearing at the front end of the line as a consequence of additional flattening. After bringing the line 5 into the tube 2, and after taking away of the drawing force, the line 5 is inclined to once again assume its original wave form with the amplitude A. The line 5 thus once again abuts at its extreme bending points the wall of the tube 2.

A number of heating tubes 2 according to the invention are drawn through the drum 1 represented schematically in Figure 2. These tubes are spatially disposed in three circular rows and are pressurized with steam from the lower-lying side of the drum via the lines 3 and the steam chamber 4, said steam condensing in the heating tubes 2. In each heating tube 2, a wavy deaeration line 5, supported alternately on opposite sides of the tube 2, is drawn in. All these deaeration lines 5 are connected on the apical side to an annular collection chamber 6 that can be deaerated from outside via several connections 7. The condensate from the heating tubes 2 collects in the chamber 8 and is drawn off via the lines 9.

The invention is not limited to the form of embodiment represented. Thus, in particular, the line drawn into the tube 2 can have, instead of the plane wavy form, also a spatial form, for example, a spiral form that is supported along a line or a row of points on the inner side of the tube. Along with this, the tube is in no way limited to a circular cross-section. The invention can also be applied in the case of tubes with oval and rectangular, e. g. square, cross-sections.

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Patent Claims

1. Tube with a tube lining guided through its interior and held on the tube wall, said tubes having a small cross-section, in particular a heating tube for condensing steam with a deaeration line, characterized by the fact that the line (5) is provided over at least a part of its length with periodic bends whose amplitude A is greater than the bore L of the tube (2) so that the line (5) is deformed on drawing into the tube and due to its restoring force abuts the tube (2) under pressure.

2. Tube according to Claim 1, characterized by the fact that the line (5) is bent in the form of a wave with point contact of the tube wall (2).

3. Tube according to Claim 1, characterized by the fact that line (5) is bent in the form of a helical spring.

4. Tube according to one of Claims 1 to 3, characterized by the fact that the difference between the amplitude A and the bore L of the tube is dimensioned so large that, in the line (5)'s deformation associated with the drawing in, the elastic range of the line material is not exceeded.

5. Tube according to one of Claims 1 to 4, characterized by the fact that the amplitude of the periodic line bending is greater than the bore of the tube (2) by 10% to 40%, in particular 16% to 32%.

6. Tube according to one of Claims 1 to 5, characterized by the fact that the pressing force of a line (5) bent in the form of a wave on the tube wall at the points of contact (12, 13) is equal to 3 to 10 times the weight of the drawn-in line length divided by half the number of contact points.

7. Steam-heated drum with heating tubes connected to a common steam chamber and heated by condensing steam according to one of Claims 1 to 6, characterized by the fact that the ends of the tubes (2) opposite the steam chamber (4) are closed and the ends of the lines (5) located near these ends of the tubes are open and the lines (5) guided back to the steam inlet ends of the tubes (2) are connected to a collector chamber (6) that can be deaerated.

[see source for 2 pages of drawings]